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Dr. Jacob D. Paz
J&L Environmental Service inc.
P. O. Box 33036
Las Vegas, NV 89133
(702)-592-3637

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Ms. Carol Hanlon
S&ER Products Manager
US DOE
Yucca Mountain Site Characterization Office
P.O. 30307 M/S 025
N. Las Vegas, NV 89036-0707

Dear ms. Hanlon:

Attached my hard copy response to the Supplement Environmental Impact Statement and Science Engineering Report. I have sand you my comments by E-mail on July the 4th. 2001.

If you have any questions please feel free to communicate either by mail or by e-mail at jlinc-lv@worldnet.att.net .

Yours truly,

Dr. Paz

Dr. Jacob D. Paz--

I. BACKGROUND

1. Yucca Mountain Project

Both the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC) have proposed radiation standards for drinking water near the YMP. The EPA (1) is currently proposing an overall radiation is protection standard of 15-mRem effective dose per year for YMP: While the NRC proposed a corresponding radiation standards of 25 mRem (2) effective dose per a year. In addition the EPA is set a drinking water standard of 4 mRem at the nearest accessible site to Yucca Mountain; and 15 mRem annual dose for YMP. The EPA applied a cancer risk factor ranging from 10^{-6} to 10^{-4}, to be consistent with the existing policy under the Comprehensive Environmental Response, Compensation and Liability Act; and more recently, the Food Quality Protection Act. The Food Quality Protection Act requires a cancer standard risk factor of no greater than 10^{-4}. The EPA acknowledged that most radioactive sites are also contaminated with non-radiological toxic chemicals, but they failed to take into account the potential synergistic or antagonistic interactions of toxic chemicals with radionuclides at low concentrations.

Neither the Department of Energy (DOE) nor the NRC has regulations or policies to address the possible problem associated with chemical interactions with radionuclides. The NRC has proposed a protection standard of 25 mRem effective dose per year for YMP (1) based on an acceptable cancer risk of 1 in 1000. A letter to Congresswoman Shelley Berkley from the NRC (2) stated "the NRC is not at this time aware of any evidence that would indicate that there is a significant health and safety issue concerning the interactions of heavy metals and nuclear waste that has not already been considered in their approval of waste transportation and storage packages. The NRC statement is not supported by references in the scientific literature or by experimental data.

Recently, there has been an increasing concern among regulatory agencies and the public over the exposure to and possible adverse effects from exposure to complex mixtures of environmental pollutants. The EPA in 1986 and in 1990 (3-4) recognized the importance of complex mixtures and issued guidelines for the risk assessment of complex mixtures. The National Research Council (NRC) in 1988 (5) addressed concerns regarding exposures to complex mixtures. The Presidential/Congressional Commission on Risk Assessment and Risk Management in 1977 (6) stated that it "considered the risk assessment of mixtures to be a matter of considerable concern and importance." Additionally, the National Council on Radiation Protection and Measurements (NCRP), in 1993 (7), specifically acknowledged that a gap exists between chemical and radiation risk estimate. In addition, the NCRP confirmed that further study is needed to address issues such as damage to the immune system, and possible combined effects of chemicals and irradiation causing either synergistic or antagonistic effects.

1 Several models for the action of mixed irradiation with two types of radiation have been proposed in the last two decades, but YMP management failed to include them in the EIS. Mixed irradiation is sometimes composed of more than two types of radiation, and for this type of mixed irradiation, no model has yet been proposed. It is of importance to assess the effect of mixed irradiation in terms of the environment, groundwater contamination, transportation accidents, space, and medicine. Theoretical models for mixed irradiation with two types of radiation have been presented by Zaider and Rossi (8); and by Scott (9) based on the Theory of Dual Radiation; Tobias et al (10); Ager and Haynes (11); Lamb (12); Suzuki (13) also have analyzed the action of mixed irradiation using their own models. However, mixed irradiation is sometimes composed of more than two types of radiation. Suzuki (14) has developed a model that can be applied to any type of mixed irradiation (i.e. any time-lag) with two types of radiation (i.e., the extended Zaider-Rossi model). He also stated that "it is difficult to extend this to a model involving more than two types of radiation and to avoid this difficulty, I limited the model to simultaneous irradiation.

In radiobiological studies, very low dose-rates are usually concomitant with very long irradiations and vice versa since the doses used are those that give rise to the changes to be determined (i.e., neither too high nor too low doses). There are no very long irradiations at high dose rates or very short irradiations at low dose-rates in studies. Therefore, the terms very low dose rate and very long irradiation have the same meaning. Though this model is limited to simultaneous irradiation, it would be useful for assessing the effects of such irradiation, because no model has been reported for mixed irradiation with multiple types of radiation and because mixed irradiation often occurs simultaneously in nature. The action of mixed irradiation must be further investigated, Suzuki (15).

2 In spite of the governmental, professional and quasi-governmental organization recommendations to the YMP management, they did not address all issues of complex mixtures in their Environmental Impact Statement (EIS) (16). This should have addressed complex mixtures including heavy metals found in the C-22 metal canisters such as (U, Mo, Cr); neutron poisoning substances; (B, Cd, Ce, Gd) used for shielding in canister; and the long-lived radionuclides (Tc-99, I-129, Np-237, U-234, Pu-239, and Pu-242). Neither did they fully incorporate the tritium groundwater plume generated as a result of 260 underground nuclear explosions at the Nevada Test Site. The Yucca Mountain environmental impact statement ignored the use of a Physiologically Based Pharmacokinetic Model (PBPK) model, which is advocated by the EPA and the environmental community to assess the impact of complex mixtures.

2. The Nevada Test Site (NTS)

The NTS encompasses 3,496 Km^2 of land in southern Nevada; it features desert and mountain terrain, and it is larger then Rhode Island, making it one of the largest secured areas in the United State. Most of NTS is located in Nye County, Nevada the Nellis Air Force Range surrounds the NTS and the YMP proposed national Repository for high nuclear waste is part of NTS. The historic activities at NTS are: include:

atmospheric weapon testing, underground nuclear testing, safety testing of nuclear weapons, nuclear weapons development, and the disposal of low levels of radioactive waste. From 1951 to 1992 more then 820 underground nuclear tests and 100 atmospheric tests were conducted at NTS (17).

About 820 underground nuclear tests have been conducted at the Nevada Test Site. Of these 259 tests are presumed to have an impact on groundwater of these 112 were detonated below the water table. Tritium is radionuclides of a major concern because of its transportation properties Hechanova and Hodge (18). The reported a tritium inventory of 69.9 MCi in the Pahute Mesa region and 30.7 MCi in the other region of NTS.

The total underground radiological contamination is about 310 MCi essentially all from underground testing. However, the 112Mci underground radiological source term considered in the EIS as being available for potential mitigation is just the total from all underground tests that were conducted beneath the water table or within 101 Meter of the top of the water table, and which 90% of this is tritium DOE (19). The toxic materials present after nuclear detonation occur in three locations: 1). Incorporated into the melted glass pools in the bottom of the cavity, 2). Deposited on the rubble and along fractured surfaces within and outside of the cavity, 3). And gases that escape into the atmosphere within a short time after detonation. The distribution of radionuclides is complex, and their behavior or deposition is not well understood Smith (20).

Non-radioactive hazardous substances used in nuclear weapons testing can be divided into activities the surface from pre and post-detonation drilling; or during scaling of the shot hole hazardous waste materials. For example several tons of lead, a few kg of other hazardous materials such as arsenic and gallium and various organic compounds are used. In practice, the non-radioactive hazardous waste is also of interest because it may lead to species that are complex with hazardous compounds, which may promote their transportation. No unclassified estimate is available concerning the identity quantities of such hazardous such hazardous and their potential impact on groundwater quality remains unknown.

The cumulative risk from all the 77 other then tritium radionuclides was below the primary public dose standard (recommended by national and international experts at 100 mRem effective dose per year). We then compared our estimates to the EPA's Clean Drinking Water Act and found that except for tritium and strontium-90, the cumulative ratio from all the other 76 radionuclides complied with the regulation. Hechanova and Hodge (19) also assumed that the public would not be living on the NTS with their drinking water wells intercepting a nuclear test cavity. In addition, their assumptions apply for the near-future since our numbers indicate that tritium will decay to the primary public dose standard in 118 years. The drinking water dose would be about a tenth of an mRem per year, which is a small fraction of background dose received in one day.

There is considerable uncertainty concerning the actual quantity of radioactivity that can be mobilized by leaching of contaminated subsurface debris by groundwater. Smith et al., (21) have summarized the uncertainties associated with leaching for the NTS and concluded that the radionuclides most likely to become mobile and migrate via the groundwater regime are: (1) tritium; (2) a number of anions and neutral species such ac Tc-99, Ru-106, Cl-36, and I-129, all assumed to migrate at the same rate as groundwater; and (3) cationic species, including Sr-90, Cs-137, Co-60, Zr-95, Pu-239, and others, that are believed to move more slowly than groundwater to varying degrees. It should be noted that Zr--95, and Ru-106, all have half-lives less than three years and are not likely to pose a groundwater hazard; the same is probably true for cobalt-60 with a half-life of 5.2 years. However, quantitative estimates are highly uncertain to the point of being almost non-existent. There has been essentially no study of whether the substantial fraction of the radiological source term that was deposited above the water table is moving downward into the saturated zone Borg, et al.,(22); and Kcrsting et al., (23).

The situation related to retardation of radionuclides transportation and by sorption onto rocks is somewhat better than for leaching, with several studies having been conducted. Tritium is appropriately assumed to move at the same rate as the groundwater. However, documentation for most other radionuclides indicates that retardation factors vary significantly with respect to water composition, experimental conditions, and rock type. The causes of the variations are speculative Smith, (22). In fact, Daniels, (24) assumed no sorption of any radionuclides because of the limited database. Insoluble or highly retarded radionuclides can be transported by forming or attaching to colloidal particles, which then move essentially at the same rate as the groundwater in which they reside. Kersting, (27) concluded that a substantial fraction of radionuclides could be associated with colloids, but the effects on transportation are not known. Contaminant transport by non-radioactive organic chemicals or degradation products thereof has not been studied or taken into account.

Tritium, which is not absorbed and moves at the same rate as groundwater, is the radionuclides considered almost exclusively by DOE in risk analyses. Other radionuclides were assumed by DOE to move very slowly as compared with tritium and, therefore, were not generally considered in the assessments. However, before 1997 about a dozen instances of migration of radionuclides other than tritium have been documented Nimz and Thompson, (25). The largest distance of migration of radionuclides other than tritium was not then known to have exceeded 500 m (1,640 ft). Migration of tritium is more difficult to interpret, but is thought to have migrated no more then several kilometers, although tritium, with a half-life of 12.3 years, is not likely to pose a long-term threat to the groundwater resources at NTS.

Pahute Mesa, which is the location of most of the U.S. large nuclear explosions, contains approximately 70 percent of the tritium at the NTS. Modeling results also indicate that groundwater flow paths from Pahute Mesa are the shortest of all those at the NTS site and constitute the highest potential for contamination migration to off-site public receptors IT Corporation (26). From recent analysis of water from a well near the

TYRO nuclear weapon test site on Pahute Mesa the experimental data show that Pu-239 seem to be immobilized in groundwater, however test of two wells near the TYBO underground nuclear test at Pahute Mesa, at the Nevada Test Site. Test results showed that presence of Pu-239 in association with colloids, found at significant levels in well number ER-20-5 #1 at a depth of 860 m. While, at well number ER-20-5 #3 30 m south of #1 only a very small amount of Pu-239 was detected. Kersting et al., (27). All of the Pu-239 was shown to be associated with colloidal particles.

The uptake points for radionuclides are generally assumed to be springs in off-site locations such as Oasis Valley to the southwest of the NTS. This assumption has implications for institutional management of the NTS. For example; the underground tests conducted within the NTS boundaries groundwater-modeling studies have been performed by Daniels (24) and GcoTrans (28). Both of these studies evaluated the migration of tritium from test, location on the Pahute Mesa to Oasis Valley. In addition, the GeoTrans study examined migration flow paths from Pahute Mesa to Amargosa Valley and from Yucca Flat to the boundary of the NTS south of Mercury. Nevada.

The GeoTrans (28) results for tritium were far below 20,000 pCi/L., which is EPA's allowable tritium concentration in drinking water. The study reported by Daniels (24) predicted much higher values. The estimated range of peak tritium concentrations at the closest uncontrolled use area varies from $5x10^{-4}$ pCi/L (arriving 150 years after the beginning of migration) to 3,800 pCi/L (arriving in 25 to 94 years). The hypothetical maximally exposed individual at this location is estimated to have a lifetime probability of contracting a fatal cancer between 8×10^{-12} (about one in one trillion) and 1×10^{-5} (about one in 100,000), depending on which model is used. These estimates are self-characterized as being conservative. The results indicate that at the Area 20 (Pahute Mesa) boundary of the NTS and at Oasis Valley the lifetime committed effective dose for other radionuclides is about 10 percent of that from tritium. Important radionuclides other than tritium were Sr-90, I-129, Cs-137, R-226, Pu-239, and Am-241. The risks from toxic chemicals used in nuclear weapons tests have not been estimated.

Of the big concern is the Underground Test Area Program (UGTA) strategy does not utilize risk as a major factor in how and where the DOE applies its resources to protect human health from contaminated groundwater at the NTS. Since the DOE does not have enough data to define adequately the hydrologic source term, an acceptable risk assessment for the groundwater contamination cannot be properly developed at this point. The baseline risk assessment for the NTS groundwater contamination is described as incomplete since it only characterizes the radioactive isotope tritium. UGTA risk assessment ignored the potential health effect of mixed irradiation and toxic chemicals.

The focus on tritium is logical because it enters the groundwater easily since it is an isotope of hydrogen, and it has the highest inventory of any radionuclides at the NTS. But other radionuclides may travel as conservatively as tritium, and not be retained in the aquifer materials contaminated by testing. Np-237, Tc-99 are thought to

be isotopes that can simulate tritium-like migration. In fact, neptunium is the major long-term culprit predicted to carry contamination from Yucca Mountain to offsite, down gradient locations. Since the DOE does not know the concentration of all radionuclides in the groundwater from nuclear testing, it cannot conduct an acceptable risk assessment for UTGA problem.

If the UGTA strategy were to incorporate risk as a driver in the quest to understand, locate, and protect human health from contaminated groundwater, then one must look to the northwestern section of the NTS called the Pahute Mesa area. Pahute Mesa is where the largest and deepest underground nuclear tests were conducted in the volcanic rock aquifers. Specifically, in the western Pahute Mesa area some shots were conducted so close to the NTS boundary that contamination may have been injected off the NTS and into U.S. Air Force lands. The distance from western Pahute Mesa to offsite, down gradient of about 15 miles Dixon (29).

3 In conclusion, YMP risk assessment dose not been fully and properly incorporates the UGTA into their risk assessment, which raises a very serious scientific question such as: what is the full impact of the groundwater from UGTA on YMP risk model? The only way to address those scientific issues is by additional research. YMP and NTS managements must work closely together and developed appropriate risk assessment model base upon experimental data integrating PBPK model, and complex mixtures testing.

II. RISK MODLES

So-called "risk models" actually carry out a part serious of that go into risk assessment. These models identified the pathways of exposure and calculate human intake, dose and detriment. They generally take the levels of contamination in soil and surface water as an input; these quantities must be measured, calculated by separate models, or in the case of an integrated performance assessment models calculated by a separate submodles. Risk models implement the Risk Assessment for Superfund, which combines a linear "box model" of ecosystem transfers with coefficients published by the EPA that give the harm per unit chemical contaminate ingested by human being. The Coefficients for carcinogens are based on a linear no-threshold model; for non-carcinogens there is assumed to be a threshold bellow, which no harm occurs. For radionuclides, the risk coefficients are driven from human exposure data and are published by the International Commission on Radiological Protection, and the National Council of Radiation Protection Measurements.

1. Physiologically Based Pharmacokinetic Model (PBPK)

Mechanistic risk assessment approaches for single chemicals are fairly well developed but for chemical mixtures they are only in the developmental stage. The default approach in mixture risk assessment assumes additively in terms of the dose or the response. Whereas the response additively is applied for carcinogens, the dose

additively is applied in the case of systemic toxicants acting by similar mechanisms. The additively assumption is valid only when there is no significant interaction among the components of the mixture at the exposure, toxicokinetic, and toxicodynamic existing levels at exposure concentrations in both the test animal species and humans.

Several environmental chemicals can interact with each other by various mechanisms that are dependent on the dose, dosing regimen (i.e., single or repeated exposure), exposure and/or exposure route of one or both chemicals. Most of the interaction studies reported to date has been conducted in laboratory animals by administering high doses of one or both chemicals by routes and scenarios often different from anticipated human exposures. Further information on the toxicological consequences of low-level or chronic exposures to binary chemical mixtures, which show significant interactions when administered acutely, is often unavailable.

Typically, in the health risk assessment process for chemical mixtures, the available data on toxic interactions among components are not taken into account. The present situation generally neglects data on binary chemical interactions showing for example, (synergism, or antagonism) and also fails to allow for predicting the potential modulation of binary chemical interactions by other chemicals present within complex mixtures.

These concerns can be addressed with the use of a physiologically based modeling approach. Physiologically based Pharmacokinetic modeling (PBPK) refers to the process of reconstructing mathematically the anatomic physiological characteristics of the organism of interest and describing the complex interplay among the critical determinants of toxicokinetics and toxicodynamic. The biological and mechanistic basis of the physiological modeling approach allows the conduct of various extrapolations (high dose to low dose, route to route, species to species, scenario to scenario, and binary to more complex mixtures) of the occurrence of toxicokinetic interactions among components of chemical mixtures.

The PBPK divides the body into various tissue compartments interconnected by blood circulation. The PBPK takes into account individual mechanisms for uptake compounds into various tissues layers, their values and metabolism. A PBPK contains mechanism for removal from the body by, for extensions ion (urine and feces). Overall the PBPK can describe, and with independent parameters, predict the distribution and the fate of a compound. While there are good examples of PBPK models applied to chemical mixtures, there has been very little work on the application of PBPK models to heavy metals and radionuclides El-Masari et al., (30); Simons (31); Pelekis and Krishnan (32); and Leavens and Bond, (33). There are very few irradiation PBPK models: The International Commission on Radiological Protection (ICRP) in 1993 developed a biokentic model for Uranium Leggett (41). This model was carried out in three steps: First, described is the intake of Uranium by blood; Next is the turn over by plasma and kidneys, and finally a simplified model which is extended to children. ICRP stated, " The model structure can be applied to Strontium, Barium, Radium and Lead.

O'Flaherty (35) in 1998 published an excellent review of a physiologically based model of metal kinetics for arsenic, lead, chromium and mercury. The metals for which PBPK model have been developed or are in progress are As, Pb, Hg, and Cr. The most fully understood of these four PBPK models is the PBPK model of human lead kinetics the other three models are in various stages of design, calibration or validation. Thomann et al., (36) in 1994 had developed a preliminary kinetic model for Cr^{+6}; O'Flaherty in 1996 he developed a PBPK model for Cr^{+6} and Cr^{+3i}. There is a PBPK model based upon inhalation and Menzel (37) has proposed distribution model of Ni in 1988.

4 In conclusion the PBPK modeling is an important tool for improving the accuracy of human health risk assessment for hazardous substances in the environment. The proper use of PBPK model can reduce the uncertainties that currently exist in risk assessment, and provide more scientifically credible extrapolations across species, routes of exposure, metabolism and exertion. The PBPK modeling helps to identify the factors that are most important in determining the health risks associated with exposure to chemicals. The PBPK model provides a mean for estimating the impact of these factors both on the average risk to population and a specific risk to an individual Cleweel (38).

2. Interactions between Metals and Radiation

5 There is extensive literature review concerning interactions between wide range of metals and radionuclides. However DOE-YMP management has not addressed the potential interactions between specific radionuclides, heavy metals and neutron poisoning elements. In a recent report Lizon and Fritsch (39), stated, "Further studies are needed to characterize the cell death mechanism and the potential synergistic effects of chemical toxicity and irradiation". Katsifis et al., (40), showed that exposure to of human lymphocytes to Cr^{+6}, and Ni^{+2}, and UV or X-rays produce a combined effect they have shown to increases inhibition of DNA repair.

Beyersmann (41) noted that the carcinogincity and genotoxicity of Cr, Co, and Ni strongly depended on their chemical speciation. Exposure to these metals plus Uv-irradiation and an alkylating agent enhances their effect on DNA-damage. Hong et al., (42), studied the hematopoietic function in female B6C3F1 mice exposed to 0.1% and 5% of chemical mixture stocks of 25 groundwater contaminants for 31.5 weeks. The experimental data showed that exposed mice induced stress on the hematopoietic system (an antagonistic effect) following exposure to chemicals and repeated irradiations.

Kotove et al., (43) exposed mouse embryos to combined impacts of Cd^{+2} and gamma irradiation, and show an additive adverse effect on metallothioneins in the bone marrow and on liver function. Flower et al., (44) reported that the exposure to rat kidney cell line (NRK-52E to heavy metals to Pb, As, and Cd). The test results showed that the combined exposure of Cd and as at concentrations of 10^{-6} M produced an additive or synergistic interaction. Svoboda and Kotaskova (44) studied the combined effects of

internal exposure of Pu-239 and Am-241 on stem cells. The authors concluded that; an intermediate time frame between acute and chronic exposure for internal exposure to Pu-239 or Am-241 combination caused severe damage to vertebral marrow hematopoietic stem cells (CFU). The radiation impact on CFU consists of a reduction of cell number and an increase in irradiation sensitivity for surviving cells.

Bensimon (46) evaluated the impact of x-ray irradiation on human lymphoblastoid: in the first experiment, cells were cultured in media supplemented by nickel sulphate, irradiated in same media and cultured in same media after irradiation. In a second experiment, cells were cultured during 18 hrs. in media supplemented by nickel sulphate, and then cells were washed and cultured in normal media where they were irradiated. The nickel sulphate toxicity appears as an increasing function of the nickel sulphate concentration and the nickel sulphate action endurance. The X-Rays amplified the toxic effects of addition nickel sulphate. This amplification is a time function that depends on the X-Ray dose, nickel sulphate concentration and period of time from the outset of culture to the irradiation. The nickel sulphate toxic effect appears faster when nickel works after X-Ray irradiation.

Hartwing and Dally reported (47) an in Vitro study they exposed of HeLa cells to Ni^{+2}, and Cd^{+2} and UV. They exposed HeLa cell in issue culture to 254 nm UV and to Cd^{+2} levels ranging from 1 to 10 μM Cd^{+}, and Ni^{+} concentrations ranging from 50 to 250 μM respectively. The test results demonstrated an inhibition repair of various DNA types the degree of inhibition was dependent upon the concentrations of Cd^{+2} and Ni^{+2} and duration of exposure to UV.

Compounds of Ni, Cd, Co, As, and Cr are well-established carcinogens to human and animals. However, the mechanism leading to tumor formation is still not understood, since the induction of DNA damage and the mutagenic potential are rather weak and mainly restricted to cytotoxic concentrations of metals. In contrast, cytotoxicity and genotoxicity enhancing effect in combination with other DNA damaging agents are more pronounced and are an observed at lower concentrations Hartwing (47). Based upon these findings, Hartwing et al., (48) have proposed carcinogenic metal compounds may interfere with the repair of different types of DNA lesions. In addition, three reports in the professional literature have stated and cited by Lee (49), "that the carcinogincity of Nickel is enhanced by the presence of other carcinogens such as: arsenic, and hexavalent chromium Lumb et al., (49) Sen et al., (50) and EPA (51)".

III. YMP and RCRA SITE

6 The potential risk of YMP of becomes RCRA site in the future because; metal corrosion of canisters, C-22 metals, and engineering shields into the environment has not been properly and completely addressed. YMP management must addressed all the applicable regulations associated with the Resource Conservation and Recovery Act (RECRA); specifically 40 CFR268, of site disposal of carcinogenic and toxic heavy metal such as: U, Co, Ni and Cr at YMP.

7 Okrent and Xing (53) in 1993 published an excellent paper they discussed the issue such as:

1. Risk assessment associated with exposure to heavy metals at YMP.
2. Six scenarios of exposure pathways of heavy metals and health risk.
3. Finally, the authors also stated "It should be acknowledge that EPA indeed considers the near future situation of RCRA site.
4. Additionally the, under current EPA regulations 40 CFR 268.12 of Land Disposal a RCRA site could not be in a seismic active region.

If Okrent and Xing they are correct than YMP site must be excluded as a suitable site for high-level waste geological repository. This issue must be further and completely addressed by all the following federal agencies such as USEPA, YMP-DOE, NRC and the state of Nevada.

IV. ZEOLITE ABSOPRPTION OF HEAVY METALS AND RADIONUCLIDES

Review of the YMP-Science and Engineering Report 2001, noted extensive work has been devoted to the sorption of radionuclides by Zeolite. The absorption of heavy metals from canisters, rods, and engineering shielding has been ignored, what is the scientific basis to exclude them from such study? Dose YMP-model prediction the rate of release and of heavy metals into the environment based upon scientific experimental data? Another question or uncertainty is what will happen in case heavy metals will be absorbed by Zeolite and rich the breaking point? What impact will it have on the mobility, migration rate, and affinity, of radionuclides and heavy metals releases into the groundwater and the environment? This uncertainty can be only addressed by an additional research.

V. COUNCLUSION

In conclusion, the following questions to must be asked: Why did Yucca Mountain Project management not follow the call in the professional literature for additional research interaction between chemicals and irradiation? Furthermore, there are more than 1000 published reports showing interactions between radionuclides and toxic chemicals. Is it basic research as it stated by YMP-managements or it is applied research? Why did YMP-management ignore the Suzuki model for mixed radiation (soil and/or groundwater at very low concentration?

Why YMP groundwater risk assessment dose not been fully and properly incorporates the UGTA into their risk assessment, which raises a very serious scientific question such as: what is the full impact of the groundwater from UGTA on YMP groundwater and health risk model? The only way to address these scientific issues is by additional research. YMP and NTS management must work closely together and developed appropriate risk assessment model base upon experimental data integrating a PBPK model, and complex mixtures testing which they have not done yet.

YMP management must address properly and accurately when YMP geological repository will become an RCRA site in the future. The question is how are they going to comply with all 40 CFR 268 regulations? Last, if YMP will become a RCRA site, which is in a region that is active seismic region, than Yucca Mountain as, a repository should or must be excluded as selected site.

At this point of time the rate of release and absorption by Zeolite of heavy metals of radionuclides into the environment remains uncertain. The cancer risk reported in the draft Environmental Impact Stament appears to be inaccurate and need a major revision. Additional investigations must be carried out before YMP can be approved as a site for high nuclear repository.

8 And finally, must YMP employ the best available science? Both the President in a letter to Governor Guinn State of Nevada; and the Honorable Sectary of Energy Mr. Spencer Abrams they have called to use the best scientific methods for investigation of YMP as a repository. However, it is apparently that YMP-management is continue to ignore the call for use the best scientific methods for investigation of human health risk for complex mixtures.

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